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Pollution Prevention Opportunity Assessment for the Maintenance Engineering Department (Organization 8513)

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Prepared by
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Pollution Prevention Opportunity Assessment for the Maintenance Engineering Department (Organization 8513)

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Abstract

This Pollution Prevention Opportunity Assessment (PPOA) was conducted for the Maintenance Engineering Department (8513) in September and October of 2002. The primary purpose of this PPOA is to provide recommendations to assist 8513 in reducing the generation of waste and increasing the purchase of environmentally preferable products. This report contains a summary of the information collected, the analyses performed, and recommended options for implementation. The Sandia National Laboratories/New Mexico Pollution Prevention Group will continue to work with 8513 to implement the recommendations.

Acknowledgements

The author thanks Laurie Farren, Chris Armijo, Gil Arthur, Scott Keith, John Rocha, Dwight Soria, Suzanne Mello, Paul Canepa, Nora Ortega, Joseph Warren, Al DuCharme, Connie Stewart, Leighton Ford, Mark Brynildson, and Lee Gardizi for gathering data and developing the alternatives identified in this report.

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Executive Summary

The Maintenance Engineering Department (8513) is responsible for preventative and regular maintenance of Sandia National Laboratories/California's (SNL/CA) facilities and grounds. 8513 has implemented numerous waste reduction measures. However, even with these reductions, the department remains one of the largest generators of Resource Conservation and Recovery Act (RCRA) hazardous and California-regulated waste at SNL/CA. This Pollution Prevention Opportunity Assessment (PPOA) was conducted to provide recommendations for possible waste reduction measures for RCRA hazardous and California-regulated waste streams and to increase purchases of environmentally preferable products. The PPOA team consisted of personnel from Environmental Compliance, Waste Management, Pollution Prevention (P2), and 8513. This interdisciplinary team was responsible for evaluating processes and waste streams and generating the P2 opportunities identified in this report.

The largest recurring waste streams for 8513 are paint-related wastes, solvents, oils and greases, and aerosol cans. The Paint Shop generates approximately 30 percent of the total volume of hazardous waste. Because its processes generate such a large percentage of 8513's hazardous waste, the Paint Shop will be addressed in *Pollution Prevention Opportunity Assessment for Facilities Maintenance Team (FMT) Paint Shop.* The PPOA team for 8513 evaluated the waste stream data and potential waste reduction ideas based upon effectiveness, feasibility, and cost. Six opportunities were selected for further consideration. These opportunities showed annual cost savings with quick payback periods and would be effective in reducing the hazardous and solid waste generated by 8513. The following six P2 opportunities are recommended for implementation:

Opportunity 1: Reusable Aerosol Cans

Opportunity 2: Wood Chipper

Opportunity 3: Environmentally Preferable Product: Addition of Biodiesel at SNL/CA

Opportunity 4: Environmentally Preferable Product: Custodial Products

Opportunity 5: Environmentally Preferable Product: Re-refined oil

Opportunity 6: Environmentally Preferable Product: Electric Utility Vehicles

Acronyms and Abbreviations

8513	Maintenance Engineering Department
B20	20 percent biodiesel
CFR	Code of Federal Regulations
dBA	decibel(s) (A-weighted)
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EUV	Electric Utility Vehicle
FAR	Federal Acquisition Regulations
FMT	Facilities Maintenance Team
FY	Fiscal Year
MSDS	Material Safety Data Sheet
OS1	ManageMen® Operating System
P2	Pollution Prevention
PNNL	Pacific Northwest National Laboratory
PPOA	Pollution Prevention Opportunity Assessment
RCRA	Resource Conservation and Recovery Act
ROI	Return on Investment
SNL/CA	Sandia National Laboratories/California
SNL/NM	Sandia National Laboratories/New Mexico

1.0 Introduction

The Pollution Prevention (P2) staff of Sandia National Laboratories/New Mexico (SNL/NM) conducts pollution prevention opportunity assessments (PPOAs) for organizations within SNL/NM and Sandia National Laboratories/California (SNL/CA). The goal of a PPOA is to identify practical, cost-effective strategies to do one or more of the following:

- Reduce overall resource use
- Reduce or eliminate the generation of waste
- Reduce waste volumes and toxicity
- Increase purchases of environmentally preferable material
- Reduce energy and water consumption
- Reduce the line organization's operational costs

The completed PPOA is presented to the organization for implementation. The P2 staff will assist with implementation as much as possible through providing technical and administrative support and seeking funding options when necessary.

This PPOA was conducted for the Maintenance Engineering Department (8513) at SNL/CA in September and October of 2002. A preliminary assessment (*Initial Data Gathering and Opportunity Identification [Task 1 and 2]*, SAND 2002-8476) of all waste generators at SNL/CA identified 8513 as a significant generator of hazardous waste.

The primary purpose of this PPOA is to recommend strategies and technologies to eliminate or reduce 8513's hazardous waste streams. For the purposes of this report, hazardous waste includes waste defined as hazardous by the Resource Conservation and Recovery Act (RCRA) as well as the State of California Environment Department. Other considerations include solid waste streams, purchasing environmentally preferable products, energy and water conservation, and overall reduction of resource use. The process used to perform this PPOA is outlined in Figure 1. This report contains a summary of the information collected, the analyses performed, and recommended options for implementation. P2 staff members from both SNL/NM and SNL/CA will work closely with 8513 to implement these options.

The PPOA team consisted of staff members from P2, the Facilities Maintenance Team (FMT), the Tool Crib, and the Warehouse, as well as other engineering and operations personnel. This interdisciplinary team was responsible for evaluating processes and waste streams and generating the P2 opportunities identified in this report. Information was collected through interviews with facility personnel, site visits, and evaluation of waste disposal and purchasing databases. Waste disposal data was collected for fiscal year (FY) 2000 through the second quarter of FY 2002. P2 alternatives were identified through informal processes, such as brainstorming with key personnel, and screened based upon feasibility and practicality. Finally, a cost-benefit analysis was performed on the selected alternatives to identify costs and the return on investment (ROI) for implementation.

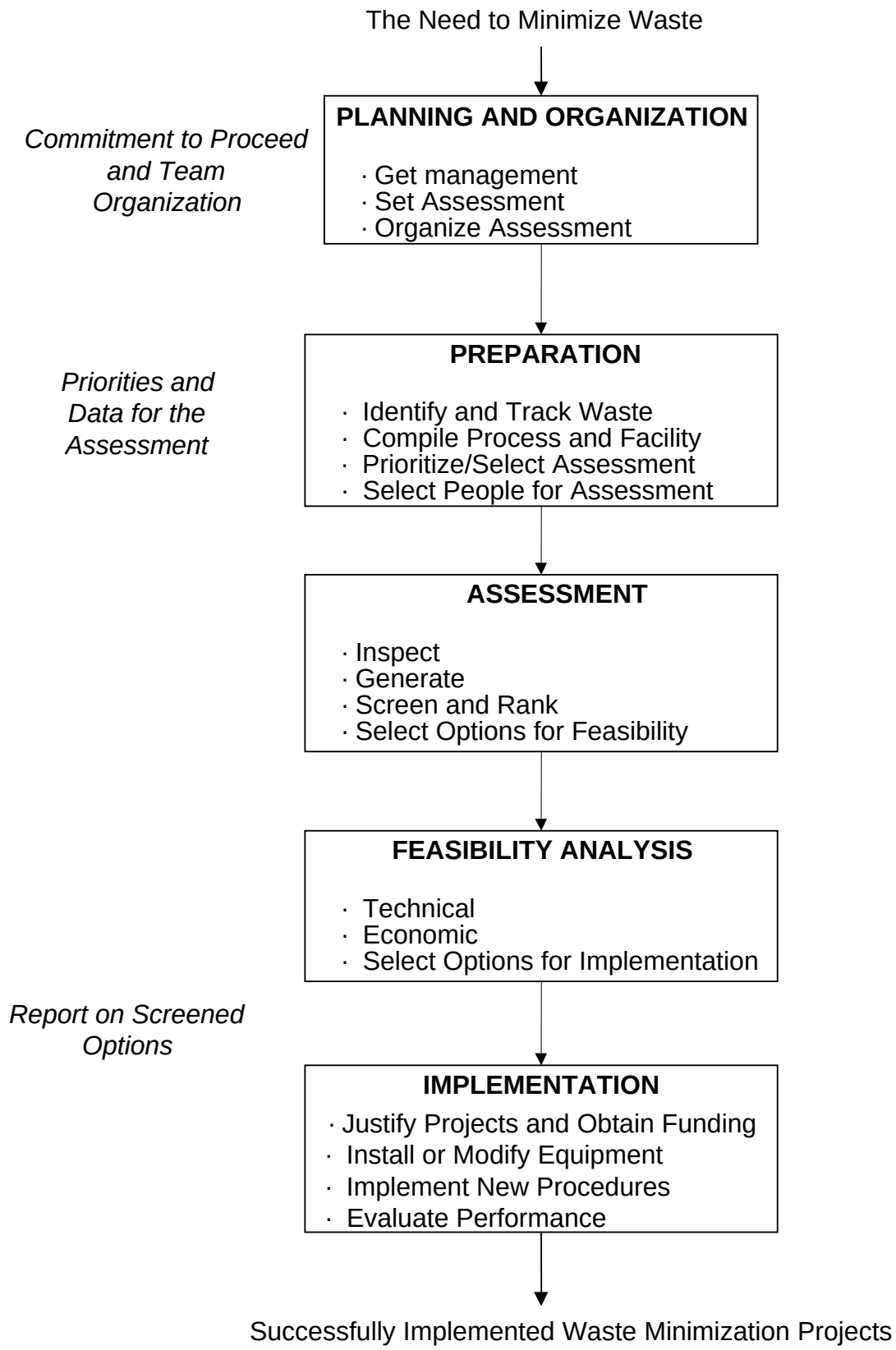

Figure 1. Pollution Prevention Opportunity Assessment Process.

This report documents the results of the PPOA of 8513 operations excluding the Paint Shop and its purchasing practices, which are addressed in *Pollution Prevention Opportunity Assessment for Facilities Maintenance Team (FMT) Paint Shop.*

2.0 Facility Description

Sandia established its California site in 1956 to support weapons engineering with its across-the-street neighbor Lawrence Livermore National Laboratory. SNL/CA employs slightly more than 1,000 persons, and its facilities consist of 60 buildings on 413 acres. The current FY budget for SNL/CA is more than $152 million.

SNL/CA research is focused on manufacturing-related research including microelectronics, nano-technologies, combustion research, materials synthesis and processing, materials characterization, process simulation, engineering theory and design, prototype fabrication, and demonstration techniques. Applications include welding technologies, semiconductor fabrication, sensors, high-performance metals, ultra-hard ceramic coatings, and computational modeling and analysis.

Organization 8513 is a subgroup of California Site Operations, Center 8500. 8513 provides maintenance services to existing SNL/CA structures and grounds. Services include grounds maintenance and landscaping, painting, plumbing, structural repairs and minor remodels, sheet metal work, electrical repairs and upgrades, and preventive maintenance of air compressors, cranes, and hoists. Maintenance Warehouse Operations is also part of 8513 and is responsible for ensuring that materials required for 8513 to perform work, including oils, chemical products, and equipment, are available on a timely basis.

3.0 Assessment Methodology

This PPOA is one of a series of assessments that will be performed at SNL/CA. A preliminary assessment, *Initial Data Gathering and Opportunity Identification (Task 1 and 2),* SAND 2002-8476, ranked various SNL/CA organizations according to potential waste reduction opportunities. Criteria included high waste generation rates, high probability for success, ease of implementation, and potential for "green" purchasing and energy reduction. 8513 was targeted for further assessment based upon the quantities of waste generated and the likelihood that P2 opportunities could be easily implemented.

As depicted in Figure 1, the major steps of a PPOA include planning, preparation, assessment, feasibility analysis, and implementation. For this PPOA, the planning and preparation portion involved reviewing information from the initial assessment and identifying the major waste streams generated by 8513. The largest waste streams identified were correlated with specific 8513 operations.

The assessment phase consisted of a four-day site visit by a member of the SNL/NM P2 staff. During the visit, extensive interviews and discussions were held with personnel from 8513, Facilities Planning and Engineering (Organization 8512), and Environmental Operations (Organization 8516). Site tours were conducted encompassing all 8513 operations and activities,

excluding the Paint Shop. This phase focused on clarifying how waste is generated and encouraging personnel to share ideas about P2 opportunities. Several brainstorming sessions were held with the major waste generators to consider opportunities for P2.

The information from the assessment was compiled and descriptions of waste volumes and the accompanying processes refined. Additional sessions to gather information and continue brainstorming were conducted on the phone and via e-mail.

Once P2 opportunities were identified, each one was evaluated according to criteria that included technical feasibility, regulatory issues, and ROI. Both vendors and SNL/CA compliance personnel were consulted. The options that were satisfactory from a technical and regulatory standpoint were then analyzed for potential ROI. This is discussed in more detail in the Cost-Benefit Analysis (Attachment 1).

The results will be presented to 8513 management for implementation. Although the implementation phase is not included in this report, it is the most important part of the process. P2 personnel from SNL/NM and SNL/CA will assist 8513 personnel with implementation wherever possible. 8513 will be expected to request funding for P2 opportunities and to take the lead on purchasing, installing, and operating new equipment. P2 personnel will also evaluate various sources to identify funding options and will provide technical and regulatory assistance on an administrative level.

4.0 Waste Streams

SNL/CA tracks wastes based upon regulatory requirements. The two most costly and frequently generated waste streams are known as “RCRA hazardous” and “California-regulated.” For the purposes of this report, both these waste streams will be referred to collectively as hazardous waste. These wastes are tracked from the point of generation to disposal. The database contains extensive data on each waste container including generating organization, contact, weight, and waste category. This database allows in-depth analysis of wastes generated by any organization and is also used to calculate disposal charges for each waste container, which are then assigned to the generating organization. The charges vary from $1.00 to $28.00 per kilogram depending upon the volume and types of waste. Waste costs included in this report are estimated based upon the standard disposal costs and may not reflect actual charges.

In contrast, waste classified as sanitary or solid waste is material that can be disposed of at a public landfill. SNL/CA tracks this waste by total quantity generated lab-wide. Therefore, specific information about the types and quantities of waste generated and from which organization is not available, and information about solid waste must be estimated. Costs for disposal of solid waste vary from $32.00 to $35.00 per ton. These costs are not assigned to the generator but are included in SNL/CA’s general overhead.

There is a third general category of solid waste beyond the scope of this report that consists of two types. The first category includes non-routine wastes generated from such activities as spills, deconstruction and decontamination, and environmental restoration. For 8513, these wastes include asbestos and lead-based paint waste. The second category consists of waste that

is generated irregularly or on a one-time basis and includes polychlorinated biphenyls and ethanol laser dye. Although disposal is quite expensive, totaling approximately $18,000 from FY 2000 through the second quarter of FY 2001, these wastes are not considered in this report because they are not generated during regular operations or their generation cannot be avoided.

The primary hazardous waste streams generated from 8513 operations include paint waste, solvents, oils and greases, and aerosol cans. Disposal costs for 8513 waste streams average $65,000 per year. The Paint Shop generates approximately 30 percent of the total volume of hazardous waste (Figure 2). Because waste streams have different charges associated with them, waste from the Paint Shop accounts for about 50 percent of 8513's total disposal costs (Figure 3). Because its processes generate a large percentage of 8513's hazardous waste, the Paint Shop is addressed in a separate PPOA (*Pollution Prevention Opportunity Assessment for Facilities Maintenance Team [FMT] Paint Shop*).

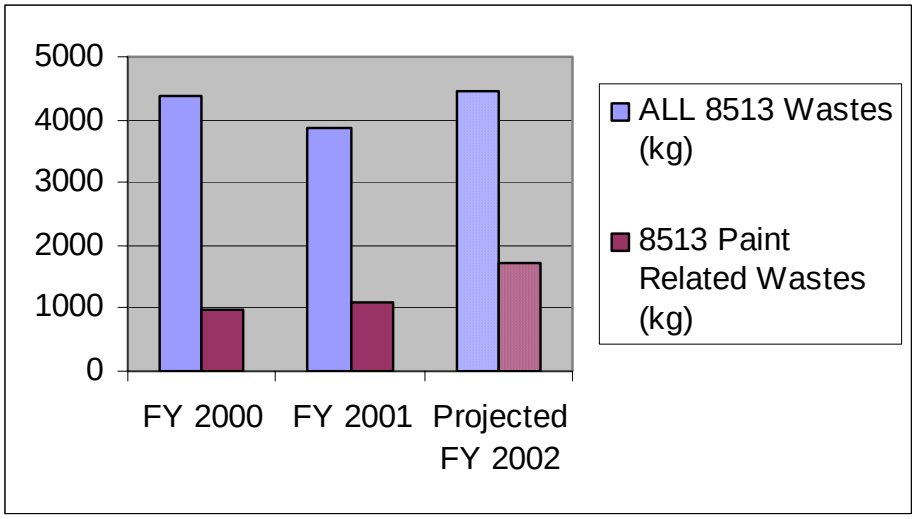

Figure 2. Total Waste Generated by 8513 and the Paint Shop.

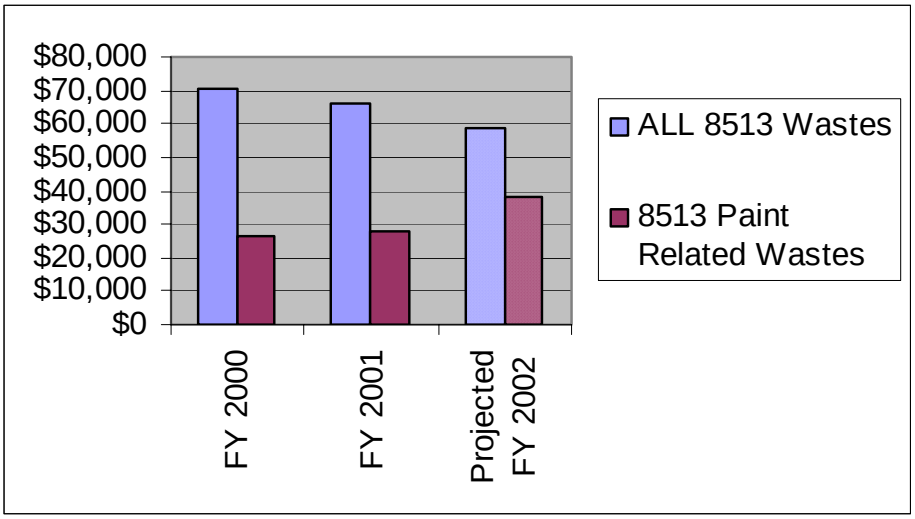

Figure 3. Cost of Total Waste Generated by 8513 and the Paint Shop.

4.1 Non-Paint Wastes

Major waste streams generated from activities other than painting include oils and greases, aerosol cans, lead-based paints, caulking and sealants, and adhesives. Because the volume of these waste streams is relatively small, and some streams are not continuous in nature, this report focuses only on the three waste streams that include oils and greases, aerosol cans, and landscaping waste.

4.1.1 Oils and Greases

In FMT operations, oils and greases are generated from the maintenance of compressors, hoists, and cranes. Oils are not tracked separately by operation, but contained in a single container for all oils generated by 8513. Because these oils are rarely contaminated and well managed, it is considered unnecessary to segregate the oils by generator.

Oily and greasy rags are frequently generated and stem mainly from oil changes. 8513 implemented a new oil management system in 2001 that uses an enclosed bulk dispensing station for lubricants, hydraulic oil, and brake fluid. The manufacturer refills this station periodically, eliminating the need to dispose of empty drums. Material is now dispensed in covered, specially marked containers, which helps to prevent contamination and spillage. The bulk storage area is protected from rain so there is little need to dispose of water and oil mixtures.

During the preliminary assessment, another waste reduction technique identified was less frequent oil changes. It was suggested that determining the quality of the oil still in the equipment could reduce the number of oil changes that have to be done. The disposal of oil accounts for a significant percentage of avoidable waste. Many scheduled oil changes can be eliminated with an on-site oil analysis program. Oil that still maintains the required viscosity,

has not been contaminated, and is still within proper lubrication specifications does not need to be changed. It is estimated that oil changes could be reduced by as much as 75 percent by using on-site oil analysis. This would reduce the generation of oil waste and disposal costs, labor to do oil changes, and the cost of restocking supplies. In addition, checking the oil condition would detect unseen wear indicators, such as metal particulates and similar contaminants. These indicators can disclose internal problems that can be dealt with before a catastrophic failure, thus reducing extended downtime, the possibility of total equipment replacement, and the potential of a spill and associated fines. It is proposed to use a commercially available portable oil testing device to facilitate this cost-reducing and time-saving program.

Most oil waste for FMT is combined with waste from other organizations in 8513. Figure 4 shows the rate of generation of oil waste for the last three years. Oil waste significantly decreased in FY 2001 due to the implementation of the new oil management system. Although the figure for FY 2002 includes only the first two quarters, it indicates that oil waste has been reduced by approximately 30 percent.

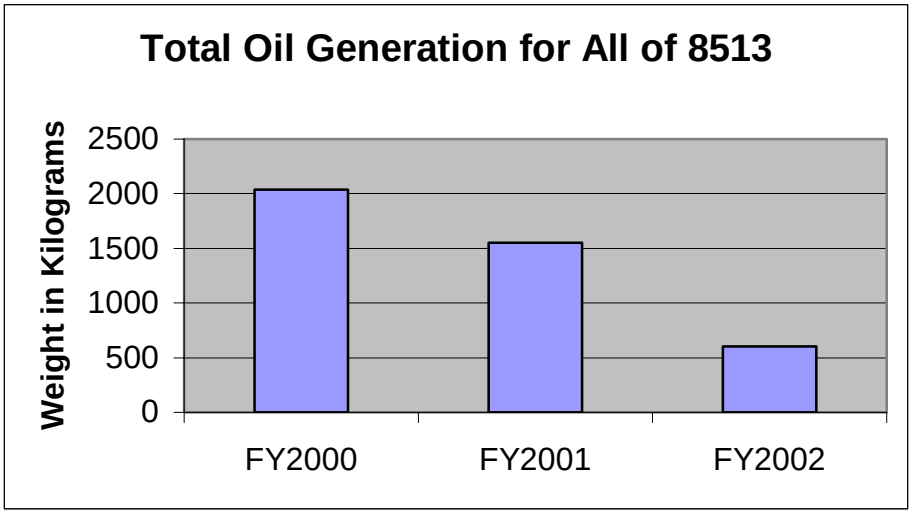

Figure 4. Volumes of Oil Waste.

4.1.2 Aerosol Cans

8513 uses a large number and variety of aerosol cans. The three major applications include automotive repair, facility maintenance, and pest control. Aerosols currently in use include battery sealant, contact cleaner, belt dressing, WD-40, starting fluid, and pesticides such as Ortho High Power Fogger, POW, Phantom, and Drop Dead. 8513 currently uses an air-pressurized reusable aerosol for brake cleaning, the only operation in which a reusable container is being applied. All aerosol cans at SNL/CA are currently being managed as hazardous waste and each organization pays the charge-back rate for hazardous waste. Figure 5 shows the rate of generation of aerosol cans for FY 2000, FY 2001 and the first two quarters of FY 2002.

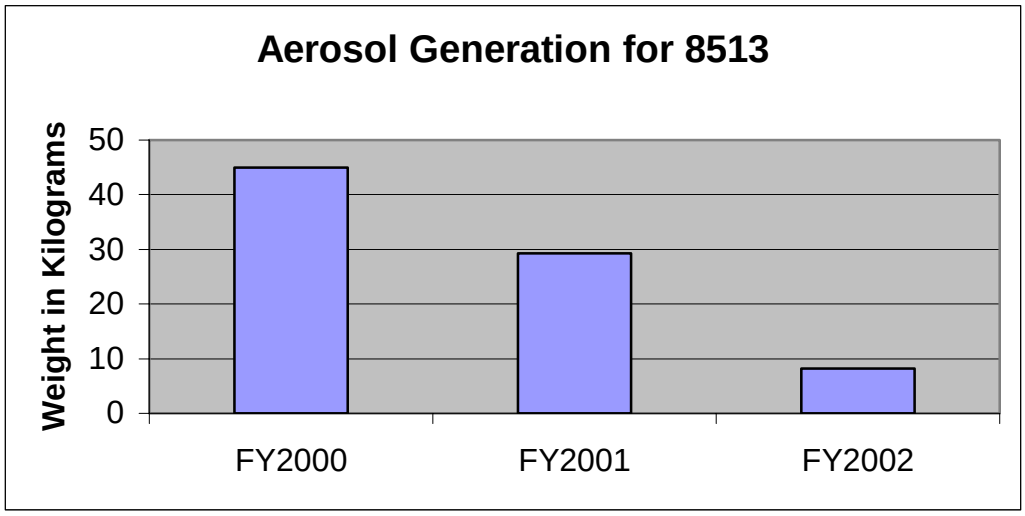

Figure 5. Volumes of Aerosol Waste.

4.1.3 Landscaping Waste

8513 makes every effort to reduce solid waste sent to the local landfill for two reasons: (1) the high cost of landfill fees, and (2) U.S. Department of Energy (DOE) solid waste reduction and recycling performance requirements. A major solid waste stream for 8513 is "green" waste, which includes lawn clippings, tree limbs, small pieces of wood, and other organic material. Approximately 660 cubic yards of green waste is disposed of per year at a cost of $6,300.00. There are numerous issues associated with managing this waste including:

- A 30-cubic-yard bin is used for debris disposal. This oversized bin creates space issues as well as logistical concerns because it must be relocated frequently to accommodate maintenance work.

- Debris has to be packed down with a backhoe to consolidate the waste in the bin, which is time-consuming, requiring two to three man-hours every day when chipping is performed.

- Debris must be taken to the local dump, which is a 1.5-hour round trip. In FY 2001, 22 loads were removed, resulting in an annual cost of $6,300.00.

In order to mitigate these issues, 8513 uses a chipper to reduce the volume of the green waste. However, this chipper is not completely effective due to its age, which is 25 years old, and safety issues. Problems with the chipper include:

- Safety Features: The chipper lacks safety features such as safety bars and automatic cut-off.

- Hearing Protection Concerns: At idling speed, the noise level is 100 to 104 decibels (A-weighted) (dBA). Workers are allowed to work for only 55 minutes at a time performing

the actual chipping process. Any worker operating the chipper may not operate any other hearing-protected equipment until the next day. This results in loss of man-hours and hearing conservation issues. Also, because of noise concerns, the chipper has to be transported to a remote area for hearing conservation resulting in an additional loss of man-hours.

- Maintenance Costs: Because of its age, parts are difficult to find, making preventive maintenance difficult. This creates additional operational and man-hour costs.

- Capacity: Because of poor design, the chipper can process wood no larger than 4 inches in size (larger debris must be disposed of), and the chips produced are not always small enough to use for mulch.

- Maneuverability: The chipper is difficult to maneuver and must be used and towed with a diesel tractor.

5.0 Environmentally Preferable Products

In Section 6002 of the RCRA, Congress directed the federal government to promote recycling by increasing its purchases of products containing recovered materials. RCRA requires the U.S. Environmental Protection Agency (EPA) to designate products that can be made with recovered materials and to recommend practices for buying these products. All federal procurement officials are required by Executive Order 13101 and Federal Acquisition Regulations (FAR) to assess and give preference to those products and services that are environmentally preferable.

"Environmentally preferable" refers to products or services that have a lesser or reduced impact on human health and the environment when compared with competing products. Environmentally preferable products include bio-based, energy-efficient, and water-conserving products as well as EPA-designated products containing recycled material. For example, copier paper was designated by the EPA on December 31, 1998, to contain a minimum post-consumer content of 30 percent. Examples of other EPA-designated products are binders, toner cartridges, letter trays, trash receptacles, tires, engine lubricating oils, cement, and carpet. A full list of EPA-designated products and the associated minimum recycle content can be found at http://www.epa.gov/cpg/.

Sandia National Laboratories is required by RCRA Section 6002, FAR Title 48 Code of Federal Regulations (CFR), Parts 23 and 52, DOE Acquisition Regulation (DEAR) 48 CFR Parts 923 and 970, as well as the DOE contract to ensure that 100 percent of its purchases of the EPA-Designated Products contain the recommended recycle content, except when not available competitively, not reasonably priced, or not consistent with performance standards. SNL/CA acquires environmentally preferable products containing the maximum practicable content of recovered materials without compromising quality.

6.0 P2 Opportunities

After evaluating the waste stream data, the team participated in a brainstorming session to develop a list of potential waste reduction opportunities. The P2 opportunities were further evaluated by the PPOA team based upon effectiveness, feasibility, and cost. Six opportunities, discussed in this chapter, are recommended for implementation. Each opportunity provides annual cost savings with quick payback periods and offers either significant reductions in hazardous and solid waste or the potential to purchase environmentally preferable products.

6.1 Opportunity 1: Reusable Aerosol Cans

Quite a number of cleaners, paints, and adhesives used in 8513 are packaged in aerosol spray cans. These cans are thin-walled steel vessels pressurized with one of several hydrocarbon propellants, such as butane. When empty, the cans may be regulated as hazardous wastes because they contain residues of hazardous products or residual propellant. In addition, aerosol cans are expensive and have greater environmental impact. Ounce for ounce, spray-on products sold in aerosol cans are roughly twice the cost of bulk products because of the cost of the propellants in every aerosol can purchased. Most aerosol cans contain 10 to 15 percent propellant by weight.

Shops and facilities that switch to refillable spray bottles are saving money by avoiding the high cost of aerosol cans and are helping to protect the environment by eliminating the solid and potentially hazardous waste stream generated. There are two basic types of refillable spray bottles:

- Metal bottles that spray product using compressed air
- Plastic bottles that use a hand pump to spray product

Refillable metal bottles more closely resemble aerosol cans in terms of design and performance. These bottles are filled with product from a bulk container and are pressurized with air at 80 to 200 pounds per square inch using a compressed air hose. Plastic bottles are also filled from bulk containers but do not require compressed air. Instead, pumping a trigger to create a mist or stream releases the product. To determine when a refillable bottle would be appropriate for an application, the following factors need to be considered.

Capacity. The capacity of air-pressurized, refillable spray bottles varies from 7 fluid ounces to 1 quart. Smaller bottles are useful for spraying hard-to-reach areas. Larger bottles are more convenient because they require filling less frequently and therefore less labor time.

Construction Material. Refillable spray bottles are available in different materials and in different finishes (aluminum, stainless steel, brass, and steel) for use with different types of bulk product. The spray bottle manufacturer can determine whether the bottle intended for use is compatible with the product.

Nozzle Type. 1-quart, refillable spray bottles come with standard spray and stream nozzles. A nozzle that can be adjusted from stream to spray is also available. Smaller bottles (16- and

8-fluid-ounce) that closely resemble the size and shape of aerosol cans and have a similar spray pattern are available.

Nozzle Extensions. Nozzle extensions up to 12 inches long are available for spraying areas that are otherwise difficult or impossible to reach.

Cost. Air-pressurized, refillable spray bottles cost from $25 to $60 each, depending upon the construction material. Chemically resistant plastic bottles and hand pumps cost between $1 and $6 per container. The product vendor can verify whether plastics are compatible with the chemical product.

Economy. Ounce for ounce, bulk product is cheaper than aerosol cans. Most common spray-on products are available in containers ranging in size from 1 to 55 gallons. Vendors may offer free refillable spray bottles with the purchase of their product.

Maximizing Benefits. Refillable spray bottles work well and can reduce costs if they are used properly according to the following guidelines:

- Avoid product losses during refilling by using funnels and pumps to minimize spills.

- Keep replacement parts on hand. Small, inexpensive parts such as nozzle seals, filler caps, valves, and nozzles may deteriorate with repeated use and pressurization.

- Refillable spray bottles will be used if they are as convenient for workers as aerosol cans; therefore, provide every technician with a refillable spray bottle for each type of frequently used aerosol product.

- Color-code similar refillable bottles to prevent cross-contamination by different products.

- Water in shop air lines may cause corrosion in some steel refillable spray bottles. Ensure that the shop air supply has a water removal device.

Attachment 1 contains a cost-benefit analysis for the use of refillable aerosol cans and bulk products. Attachment 2 provides specific information on refillable aerosol cans and bulk products currently available on the market.

6.2 Opportunity 2: Wood Chipper

A major solid waste stream for 8513 is “green” waste. Approximately 660 cubic yards of landscaping waste is disposed of per year at a cost of $6,300.00, as explained in Section 4.3 of this report. This waste stream includes lawn clippings, tree limbs, small pieces of wood, and other organic material. In order to reduce this waste stream, 8513 uses a chipper to reduce the volume of the green waste. However, this chipper is not entirely effective due to its age (at least 25 years old) and safety issues.

It is recommended that a new chipper be purchased that can fully accommodate the green waste production. Attachment 1 contains a cost-benefit analysis for the purchase of a new chipper. Attachment 3 provides specific information on chippers currently available on the market. There are several advantages to a new chipper including:

- Safety Controls: A new chipper would provide engineering safety controls, such as an emergency control bar and reverse feed options. Prior to use, the chipper will have to be evaluated for hearing conservation, but for most new chippers, but most new chippers idle at 82 DBA. This significant difference should allow the workers to chip for longer periods of time.

- On-Going Maintenance: The vendor provides maintenance training and a maintenance video as well as on-going maintenance options.

- Mobility: This chipper can be towed with a gas cart instead of a tractor, and the chipper will use less diesel than the tractor. It is also easier to maneuver.

- Flexibility: The new chipper can accommodate a 6-inch piece of wood and 100 percent of the mulch can be used at the site. Savings in disposal costs alone will be approximately $6,300.00 per year.

- Usable Material: Currently, 8513 receives no funding to purchase landscaping mulch. By producing its own mulch from the new chipper, 8513 will reduce costs for new plants as well as water use.

6.3 Opportunity 3: Environmentally Preferable Product: Addition of Biodiesel at SNL/CA

Biodiesel is a cleaner-burning diesel replacement fuel made from natural, renewable sources such as vegetable oils and animal fat. Like petroleum diesel, biodiesel operates in combustion-ignition engines. Blends of up to 20 percent biodiesel (B20) (mixed with petroleum diesel fuels) can be used in nearly all diesel equipment and are compatible with most storage and distribution equipment. These low level blends (20 percent and less) do not require engine modifications and can provide the same payload capacity and range as diesel.

Biodiesel physical properties are similar to conventional diesel. Emission properties, however, are better for biodiesel than for conventional diesel fuel. For example, biodiesel produces 12 to 48 percent less carbon monoxide emissions compared to 100-percent petroleum diesel fuels. Other benefits of biodiesel include**:**

- Easy to use: Biodiesel can be used with current fueling infrastructure and in all diesel vehicles with little or no engine modifications.

- Flexible: Biodiesel is easy to phase in and out, thus maintaining flexibility in technology deployment.

- EPAct Credits: Users receive one EPAct credit for every 450 gallons of biodiesel purchased. Users of B20, which is 20 percent biodiesel, must use five times that volume, or 2,250 gallons, to receive one EPAct credit. EPAct credits help SNL's Fleet Services' meet the intent of Executive Order 13149.

- Reliable Engine Performance: Biodiesel's high Cetane number, flash point, and increased lubricity mean excellent engine performance, safety, and fuel economy.

- Cleaner and Renewable Source: Biodiesel cuts exhaust emissions, minimizing black smoke, odor, greenhouse gas emissions, air toxins, and particulates, and does not contribute to sulfur dioxide emissions.

SNL/NM is currently using a 20-percent blend of biodiesel using soy oil through Ever Ready Oil. Because suppliers to SNL/CA may differ from those in New Mexico, a list of nationwide suppliers is included in Attachment 4.

6.4 Opportunity 4: Environmentally Preferable Product: Custodial Products

Custodial products are one of the largest categories of chemical products purchased by 8513. A reduction in the number and/or toxicity of the chemicals purchased would greatly reduce environmental and worker safety hazards. There are several options for procuring environmentally friendly custodial products, two of which are described in this section.

Option 1: ManageMen® Operating System

SNL/NM's custodial program reorganized its cleaning system in FY 2001, focusing on improved efficiency, improved safety, and reduced waste generation. SNL/NM utilized ManageMen® Operating System (OS1), a simplified, bundled cleaning and safety program for large cleaning organizations. Prior to switching to OS1, SNL/NM's custodian faced several difficulties including:

- Number of cleaning chemicals: When this effort began, 119 different kinds of cleaning chemicals were used. The chemicals were stored in 480 different buildings in custodial supply closets as well as a central supply area. These storage areas were poorly managed and caused several problems.

- Training: There was little consistency in the use and purchase of chemicals, making it nearly impossible to effectively train custodial employees in the uses of all the chemicals which caused safety risks. In addition, because of the number of chemicals, it was hard to keep Material Safety Data Sheet (MSDS) copies available with all chemicals. Often, residents of the buildings would borrow chemicals from the supply closets causing additional hazards and incidents due to lack of training.

- Overstocking: The custodial staff often used more than the necessary amount of cleaning chemicals in their processes, causing more product to be purchased. Containers often

exceeded their shelf-life due to poor tracking and had to be disposed of before the product could be used.

SNL/NM's Custodial Services tackled these problems using OS1. Changes included:

- Chemical Reduction: SNL/NM reduced the 119 different types of chemicals used to a manageable 15.

- Chemical Evaluation: Safety and environmental personnel evaluated these new chemicals to ensure they were safe for both the employees and the environment.

- Central Chemical Supply: Chemicals are no longer stored in every custodial closet. Now, there is one central supply area and ten satellite areas for the entire laboratory complex. The satellite areas have only enough chemicals for two weeks. These storage areas are kept locked and controlled. The new chemicals are now distributed in single-use packets (see Attachment 5) and are color-coded to facilitate use. For example, red chemicals have a red MSDS and are mixed in a red container. Custodians take only the amount they need for their jobs that day. At the end of the day, the empty packets are returned to the central area and counted so that any discrepancies between planned and actual use are noted and discussed.

- Inventory Monitoring: Inventory is closely monitored so that chemicals do not exceed shelf-life.

To facilitate the transition to OS1, SNL/NM Custodial Services sold all of the unused chemicals to local janitorial services and vendors through the negotiated sale process. This sale not only avoided $117, 000 in disposal costs but actually returned approximately $1,200 to the DOE. Results that SNL/NM have seen from this process include:

- Chemical Reduction: Saved $141,000 in disposal costs
- Improved Safety: Color-coding of MSDSs, ease of training
- Hazardous Waste: Eliminated 130 kilograms of hazardous waste annually
- New Mop Buckets: Reduced cleaning chemical use by 20 percent
- Negotiated Sale: Benefited local community
- Recycling: 200 broom handles, 200 restroom dividers
- New Floor Cleaners: 30,000-square-foot-per-hour increase in efficiency
- Overall Program: 10,000-square-foot-per-employee increase in efficiency

Information on the OS1 program and contact information for SNL/NM's custodial technical lead are included in Attachment 5.

Option 2: Bio-Based Cleaning Products

The Pacific Northwest National Laboratory (PNNL), which employs 3,500 research and support staff and has 2 million square feet of laboratory and office space to clean, established a process to purchase custodial products considered risk-free to workers and the environment. PNNL evaluated the ingredients in proposed replacement products to ensure that 20 specific criteria for

worker safety and environmental sustainability were met. PNNL then invited the vendors who met the criteria to demonstrate the effectiveness of their products and had the custodians test the products. The products selected include:

- General all purpose bio-based cleaner, which, by changing the dilution, can be used to clean mirrors, sinks, floors, etc., and rid carpets of the toughest stains. The all-purpose cleaner is derived from corn, oats, and soy, is neither flammable, hazardous, reactive, nor aquatically toxic, and is child-safe.

- Glass and white board cleaner, which is the same composition as the general cleaner with the addition of alcohol to prevent smearing.

- Disinfectant, which will be used up and not discarded. PNNL encourages its custodians to limit the use of the disinfectant to only necessary areas.

- Floor wax, stripper, sealer, and restorer, which generate no hazardous waste and meet sewer criteria contained in PNNL's industrial wastewater permits.

- Toilet tissue that is larger than normal and coreless. The new rolls save time because they do not have to be changed so often, reduce waste by eliminating the core and allowing use of the entire roll of paper, and contain 20 percent post-consumer recycled content.

- Toilet seat covers with 65 percent post-consumer recycled content.

- Wipers with the required 40 percent post-consumer recycled content.

- Plastic sanitary and trash can liners with 30 percent post-consumer recycled content.

Benefits that PNNL has reported since switching to environmentally friendly custodial cleaners include:

- Superior Cleaning: The bio-based cleaning product is exceeding expectations both in its performance and ability to prevent future cleaning problems, such as calcium deposits.

- Worker Protection: Bio-based cleaning products maximize protection for both the janitorial staff and other staff members that might come into contact with cleaning supplies. Reducing the toxicity of the supplies that PNNL uses through the use of bio-based products has reduced the risk of being exposed to potentially irritating or corrosive vapors from cleaning products, such as bleach and ammonia.

- Environmental Protection: PNNL's bio-based cleaning products were determined to be nonhazardous, nonflammable, nonreactive, aquatically nontoxic, and are child-safe.

- Lower Purchase Cost: PNNL noticed a greatly reduced cost of purchasing environmentally friendly products and reported a cost savings of $1,500.

- Lower Labor Cost: Labor cost is reduced due to the decrease in the amount of time required to load the carts and select the right product for the job. In addition, PNNL reported labor savings for ordering, chemical management and storage, waste handling, shipping, and disposal.

6.5 Opportunity 5: Environmentally Preferable Product: Re-Refined Oil

Re-refined lubricating oils include engine lubrication oil, hydraulic fluids, and gear oils. EPA's designation specifically excludes marine and aviation oils. The recycling of used oil has evolved from simply removing water, insolubles, and dirt to the more complicated removal of heavy metals, nitrogen, chlorine, and oxygenated compounds. Today, re-refined lubricating oil is subject to the same stringent refining, compounding, and performance standards as virgin oil for use in automotive, heavy-duty diesel and other internal combustion engines, hydraulic fluids, and gear oils. In addition, extensive laboratory testing and field studies have concluded that re-refined oil is equivalent to virgin oil, passes all prescribed tests, and can even outperform virgin oil. In fact, the three major U.S. automobile manufacturers now recognize that re-refined oil meets the performance criteria in their warranties. Currently, SNL/NM is purchasing re-refined oil, but SNL/CA is not. A list of EPA-approved re-refined oil suppliers available to SNL/CA is contained in Attachment 6.

6.6 Opportunity 6: Environmentally Preferable Product: Electric Utility Vehicles

In accordance with the Energy Policy Act and Executive Order 13149, federal agencies are required to acquire alternative-fuel vehicles and reduce the use of petroleum products through the use of alternative fuels whenever possible. Electric utility vehicles (EUVs) are the next step in fleet vehicle versatility and meeting the intent of the Energy Policy Act. EUVs are ideal for moving people, products, equipment, and other cargo around SNL/CA. Most EUVs currently on the market just plug into a standard 110-volt outlet and are fully charged within six hours. There are several models on the market that are legal for use on roads with speed limits up to 35 miles per hour. Benefits of EUVs include:

- Performance, safety, and functionality tailor-made for fleet customers
- Multipurpose use for moving people or cargo
- No need for special electrical outlets for most EUVs
- Zero-emission vehicles
- Quieter and smoother to drive than standard gas carts

Attachment 7 provides specific information for several EUVs currently available on the market.

7.0 Conclusion

The Maintenance Engineering Department has an ongoing commitment to pollution prevention by applying source reduction, using less toxic materials, and recycling and reusing materials. As a result of this PPOA, six opportunities have been identified for implementation and include:

Opportunity 1: Reusable Aerosol Cans

Opportunity 2: Wood Chipper

Opportunity 3: Environmentally Preferable Product: Addition of Biodiesel at SNL/CA

Opportunity 4: Environmentally Preferable Product: Custodial Products

Opportunity 5: Environmentally Preferable Product: Re-refined oil

Opportunity 6: Environmentally Preferable Product: EUVs

These opportunities provide annual cost savings with quick payback periods, offer significant reductions in the generation of hazardous and solid waste, and improve worker safety and operational efficiency. In addition, several of these alternatives will aid SNL/CA in meeting Executive Order 13101 Green Procurement goals.

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ATTACHMENT 1

Cost-Benefit Analysis

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Option: Refillable Aerosol Containers

Worksheet 1: Operating and Maintenance Annual Recurring Costs

Expense Cost Items	Before (B) Annual Costs		After (A) Annual Costs
Equipment : Purchase of Refillable Aerosol Containers			
Purchased Raw Materials and Supplies			
Material and Supply Costs	$2,500		$938
Utility Costs			
Labor Costs	$600		$1,300
Routine Maintenance Costs for Processes			
Process Costs			
Other			
Subtotal	$3,100		$2,238
PPE and Related Health/Safety/Supply Costs			
Waste Management Costs:			
Waste Container costs			
Treatment/Storage/Disposal Costs	$717		$359
Inspection/Compliance Costs			
Subtotal	$717		$359
Recycling – Material Collection/Separation/Preparation Costs:			
Material and Supply Costs			
Operations and Maintenance Labor Costs			
Vendor Costs for Recycling			
Subtotal	$0		$0
Administrative/Other Costs			
Total Annual Cost:	$3,817		$2,596

Worksheet 2: Itemized Project Funding Requirements (One-Time Implementation Costs)

Category	Cost $
INITIAL CAPITAL INVESTMENT	
Design	
Purchase of 6 pressurized refillable containers	$450
Installation	
Other Capital Investment (explain)	
Subtotal: Capital Investment = (C)	$450
INSTALLATION OPERATING EXPENSES	
Planning/Procedure Development	
Training	
Miscellaneous Supplies	
Startup/Testing	
Readiness Reviews/Management Assessment/Administrative Costs	
Other Capital Investment (explain)	
Subtotal: Installation Operating Expenses = (E)	$0
All company adders (G&A/PHMC Fee, MPR, GFS, Overhead, taxes, etc.)	
Total Project Funding Requirements = (C + E)	$450

Useful Project Life (L) (Years)=	5	Time To Implement (Months)=	1
Estimated Project Termination/Disassembly Cost (if applicable) (D) =			

RETURN ON INVESTMENT CALCULATION	
ROI = (B – A) – [(C + E + D)/L] x 100 =	251.26%

O&M Annual Recurring Costs		Project Funding Requirements	
Annual Costs, Before (B) =	$3,817	Capital Investment (C) =	$450
Annual Costs, After (A) =	$2,596	Installation Op Expenses (E) =	$0
Net Annual Savings (B – A) =	$1,221	Total Project Funds (C + E) =	$450

Project Title	Refillable Aerosol Containers												
Implementation Cost ($)	450						**Year Initiated**	2003					
Project Life (years)	5												
Annual Expenditures													
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Sum	Present Value in 2003
Base Case:													
annual cost	3,817	3,817	3,817	3,817	3,817	3,817	-	-	-	-	-	22,900	$21,197
													$0
													$0
													$0
Total Base Case	**3,817**	**3,817**	**3,817**	**3,817**	**3,817**	**3,817**	**0**	**0**	**0**	**0**	**0**	**22,900**	**$21,197**
											Net Present Value in 2003, Base Case		**$21,197**
P2 Project:													
implementation cost	450											450	$450
annual cost	2,596	2,596	2,596	2,596	2,596	2,596	-	-	-	-	-	15,576	$14,417
Dicommissioning Cost											-		$0
													$0
Total P2 Project	**3,046**	**2,596**	**2,596**	**2,596**	**2,596**	**2,596**	**0**	**0**	**0**	**0**	**0**	**16,026**	**$14,867**
											Net Present Value in 2003, P2 Project		**$14,867**

Results Summary:

Life Cycle Savings (NPV Base Case - NPV P2 Project) = $6,329

Life Cycle Cost Savings per $ Invested = 1406%

Real Discount Rate 3.2%

Option: Wood Chipper

Worksheet 1: Operating and Maintenance Annual Recurring Costs

Expense Cost Items	Before (B) Annual Costs		After (A) Annual Costs
Equipment			
Purchased Raw Materials and Supplies			
Process Operation Costs:			
Utility Costs			
Labor Costs			
Routine Maintenance Costs for Processes			
Process Costs			
Other			
Subtotal	$0		$0
PPE and Related Health/Safety/Supply Costs			
Waste Management Costs:			
Labor Costs	$660		
Treatment/Storage/Disposal Costs	$6,300		
Inspection/Compliance Costs			
Subtotal	$6,960		$0
Recycling – Material Collection/Separation/Preparation Costs:			
Material and Supply Costs			
Operations and Maintenance Labor Costs			
Vendor Costs for Recycling			
Subtotal	$0		$0
Administrative/Other Costs			
Total Annual Cost:	$6,960		$0

Worksheet 2: Itemized Project Funding Requirements (One-Time Implementation Costs)

Category	Cost $
INITIAL CAPITAL INVESTMENT	
Design	
Purchase	$15,600
Installation	
Other Capital Investment (explain)	
Subtotal: Capital Investment = (C)	$15,600
INSTALLATION OPERATING EXPENSES	
Planning/Procedure Development	
Training	
Miscellaneous Supplies	
Startup/Testing	
Readiness Reviews/Management Assessment/Administrative Costs	
Other Capital Investment (explain)	
Subtotal: Installation Operating Expenses = (E)	$0
All company adders (G&A/PHMC Fee, MPR, GFS, Overhead, taxes, etc.)	
Total Project Funding Requirements = (C + E)	$15,600

Useful Project Life (L) (Years)=	10	Time To Implement (Months)=	
Estimated Project Termination/Disassembly Cost (if applicable) (D) =			

RETURN ON INVESTMENT CALCULATION	
ROI = (B – A) – [(C + E + D)/L] x 100 =	34.62%

O&M Annual Recurring Costs		Project Funding Requirements	
Annual Costs, Before (B) =	$6,960	Capital Investment (C) =	$15,600
Annual Costs, After (A) =	$0	Installation Op Expenses (E) =	$0
Net Annual Savings (B – A) =	$6,960	Total Project Funds (C + E) =	$15,600

Project Title	Wood Chipper												
Implementation Cost ($)	15,600						**Year Initiated**	2003					
Project Life (years)	10												
Annual Expenditures													
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Sum	Present Value in 2001
Base Case:													
annual cost	6,960	6,960	6,960	6,960	6,960	6,960	6,960	6,960	6,960	6,960	6,960	76,560	$65,729
													$0
													$0
													$0
Total Base Case	**6,960**	**6,960**	**6,960**	**6,960**	**6,960**	**6,960**	**6,960**	**6,960**	**6,960**	**6,960**	**6,960**	**76,560**	**$65,729**
											Net Present Value in 2003, Base Case		**$65,729**
P2 Project:													
implementation cost	15,600											15,600	$15,600
annual cost	-	-	-	-	-	-	-	-	-	-	-		$0
Dicommissioning Cost											-		$0
													$0
Total P2 Project	**15,600**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**15,600**	**$15,600**
											Net Present Value in 2003, P2 Project		**$15,600**

Results Summary:

Life Cycle Savings (NPV Base Case - NPV P2 Project) = $50,129

Life Cycle Cost Savings per $ Invested = 321%

Real Discount Rate 3.2%

ATTACHMENT 2

Reusable Aerosol Can Suppliers

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Samples of Reusable Containers Currently on the Market

Product Suppliers

Company/Location	Type of Container/Product	Web Address	Telephone
Milwaukee Sprayer Manufacturing Company, Inc. Milwaukee, WI	Aerosol can substitute for cleaners, degreasers, penetrating oils, solvents and lubricants	http://www.sureshotsprayer.com	1-800-558-7035
U-SPRAY, INC 4653 Highway 78 Lilburn, Georgia 30047	Aerosol substitutes for pest control applications	http://www.bugspray.com	(770) 985-9388
Inland Technology 401 East 27th Street Tacoma, WA 98421	Aerosol can substitute for solvent applications	http://www.inlandtech.com	(800) 552-3100 (253) 593 8749
Stark & Associates Charlotte, NC	Plastic containers		(704) 332-5004
Impact Products	Plastic containers	http://www.impact-products.com/	(419) 841-2891
Tolco Corporation	Plastic containers	http://www.tolcocorp.com	(800) 537-4786
Zep Mfg. Company	Bulk cleaning product	http://www.zepmfg.com	(408) 739-3656
MOC Products Co. Inc.	Bulk Automotive products	http://www.mocproducts.com	(818) 896-2258
Tiodize Co. Inc.	Bulk Automotive products	http://www.tiodize.com	(714) 898-4377
Aubuchon Hardware	Bulk WD40	http://www.aubuchonhardware.com/brands/wd40_co-tom_bland.asp	

ATTACHMENT 3

Wood Chipper Suppliers

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Model 65 Brush Bandit Hand Fed Chipper with rain cover

Specifications:
Fueling: Diesel powered
Power: 37 Horsepower
Capacity: 6” diameter
Engine: 4 cylinder
Operational Noise Level: 82 decibels
Cal-OSHA approved
Cost: $15,600
A 3% cash discount is available

Company Information:
Bandit Industries Inc.
6750 Millbrook Road
Remus, Michigan 49340
phone: 989.561.2270 or 800.952.0178
fax: 989.561.2273
website: http://www.banditchippers.com/

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ATTACHMENT 4

Biodiesel Suppliers

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The below-referenced marketers are capable of supplying biodiesel **anywhere in the country**, and the proximity of your potential biodiesel usage in relation to a marketers listed mailing address **is not necessarily relevant to their supply logistics or price structure**. We recommend that you contact several of the listed suppliers for product and price information.

Ag Environmental Products; Lenexa, KS Phone: (402) 492-3316 -- (800) 247-1345 Contact: Steve Nogel e-mail: snogel@agp.com http://www.soygold.com	**Peter Cremer N.A.; Cincinnati, OH** Phone: (513) 471-7200 Contact: Mack Findley e-mail: Hfindley@petercremerna.com http://www.cremer-gruppe.com
American Biofuels, Inc. ; Bonita, CA Phone: (619) 479-6993 Contact: Bill Wason mailto:billwason@earthlink.net	**The Procter & Gamble Co.; Cincinnati, OH** Phone: (513) 626-2232 Contact: Donald Appleby email: appleby.db@pg.com http://www.pg.com
Baker Commodities; Los Angeles, CA PH: (323) 268-2801 FAX: (323) 264-9862 Contact: Fred Wellons fwellons@bakercommodities.com www.bakercommodities.com	**Southern States Power; Riverside, CA** Phone: (909) 367-2463 Contact: Harrison McCoy e-mail: sspowerco@aol.com http://www.sspowerco.net
Corsicana Technologies, Inc., Corsicana, TX Phone: (903) 874-9565 Contact: Tom Kowalski e-mail: tom.kowalski@corsicanatech.com http://www.corsicanatech.com	**Stepan Company; Northfield, IL** Phone: (847) 446-7500 Contact: Jeff Nelson e-mail: jnelson@stepan.com http://www.stepan.com
Filter Specialty Bioenergy, LLC.; Fayetteville, NC Phone: (910) 567-5474 Contact: Charles Jackson e-mail: 101jackson@intrstar.net	**West Central Soy; Ralston, IA** Phone: (712) 667-3200 Contact: Don Irmen e-mail: doni@westcentral.net http://www.soypower.net
Griffin Industries; Cold Spring, KY Phone: (800) 743-7413 Contact: Hart Moore jhmoore@griffinind.com http://www.griffinind.com	**West Central Soy; Ralston, IA** Phone: (913) 884-8521 Contact: Gary Haer mailto:garyha@westcentral.net http://www.soypower.net
Imperial Western Products; Coachella, CA Phone: (800) 975-6677 Contact: Tom Prokop Bob Clark e-mail: iwpbiodiesel@earthlink.net	**World Energy Alternatives; Chelsea, MA** Phone: (617) 889-9000 Order Line: (888) 785-8373 Contact: Gene Gebolys e-mail: Geneg@worldenergy.net http://www.worldenergy.net

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ATTACHMENT 5

Custodial Product Suppliers

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Option 1: OS1

Managemen® produces educational material in various media and are involved in a wide variety of productivity projects in the cleaning industry. ManageMen® provides training seminars for thousands of people worldwide.

Contact Information:
ManageMen - Ph.877.755.6711
1045 East 4500 South
Salt Lake City, UT 84117
E-Mail:info@managemen.com
http://www.managemen.com/

SNL/NM contact:
Lavone Cobb (Org. 108521)
Email: LLCOBB@sandia.gov
Phone: 505-844-8212
Fax: 505-844-5601
MS: 0930

Option 2: Bio-Based Cleaning Products

Vendor Contact Information:

Green Cleaning Products
Orison Marketing, L.L.C.
Contact: Kevin Corley
kcorley@orisonllc.com
www.orisonllc.com
Phone: 972-242-0129
2513 Blanton Drive
Carrollton, TX 75006

Green Paper and Plastic Custodial Products
Service Paper Company
Contact: Dennis Adams
DAdams7434@aol.com
Phone: 800-829-0081
3902 E. Ferry
Spokane, WA 99202

Pacific Northwest National Laboratory Contact:
Contact: Sandra Cannon
Email: sandra.cannon@pnl.gov
Website: http://www.pnl.gov/esp/greenguide/custodialproducts/

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ATTACHMENT 6

Re-Refined Oil Suppliers

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SUPPLIER

76 Lubricants Company

3535 Hyland Street
Costa Mesa, CA 92626 USA

Contact	Allen Perry
Phone	714 428-7403
Fax	714 428-7499
Email	aperry@tosco.com

Chevron U.S.A. Products Company

575 Market Street
San Francisco, CA 94105 USA

Contact	Technical Assistance
Phone	800-582-3835
Fax	415-894-8552

Coast Oil Company

4250 Williams Road
San Jose, CA 95129 USA

Contact	Mark Mitchell
Phone	408-252-7720
Fax	408-255-5263

DeMenno / Kerdoon

2000 North Alameda Street
Compton, CA 90222 USA

Contact	Richard Heim
Phone	310 537-7100, Ext. 341
Fax	310 639-2946

Evergreen Oil, Inc.

5000 Birch Street, Suite 500
Newport Beach, CA 92660 USA

Contact	Christine Dillon
Phone	714-757-7770

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ATTACHMENT 7

Electric Utility Vehicle Suppliers

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Taylor-Dunn ET3000 Electric Utility Vehicle

ET3000 operates at 18 mph and carries loads up to 3,000 lbs. Specifically designed to meet rugged outdoor applications, ET3000 is equipped with a 48 volt drive train that travels up to 30 miles in a single charge. When equipped with dual battery pack, can extend the range of the vehicle to over 50 miles.

An automotive differential and Taylor-Dunn's power traction drive provides hill climbing ability and acceleration while carrying heavy cargo during daily applications. ET3000 standard features include, steel cabin and doors, load range E tires, durable frame design, four wheel hydraulic brakes and motor design that ensures reliability and low maintenance cost.

Vendor Contact Information:
www.Taylor-Dunn.com
Contact: Brian Mac Lean, Western Regional Sales Manager
Phone: 714-956-4040
Fax: 714-956-3130
Email: bmaclean@taylor-dunn.com

Global Electric Motorcars

The GEM operates at up to 25 mph is rated on streets with a posted speed limit of 35 mph. Specifically designed to meet a variety of applications, the GEM can be configured to meet a multitude of applications.

The GEM's standard features include automotive-design 3-point safety belts, quartz halogen headlights, front and rear turn signals, and laminated tinted automotive safety glass with wipers that ensures reliability and low maintenance cost.

Vendor Contact Information:
Website: http://www.gemcar.com
Address: 3601 7th Ave. NW
Fargo, ND 58102
Contact: John Butz
Phone: 701-232-2500; 888-871-4367
Fax: 701-232-0600
Email: global@gemcar.com

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